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Massachusetts

Ring-billed, Herring, and Great Black-back Gull Study: 2008-2010 Report and Proposed Management Recommendations

Study bird breeding on an island in Lake Erie, near Port Colbourne, Ontario. Photo by Stacey Robinson

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Massachusetts Department of Conservation and Recreation
Division of Water Supply Protection
Office of Watershed Management
Natural Resources Section

Abstract

Since 2008, the Massachusetts Department of Conservation and Recreation, Division of Water Supply Protection's Office of Watershed Management has been conducting a study on the movements, food resources, and roosting patterns of ring-billed, herring, and great black-back gulls in central Massachusetts. To date, close to 900 birds have been captured and tagged with either colored wing-tags or satellite transmitters. Almost 2,500 sightings of wing-tagged gulls have been reported and over 40,000 satellite locations have been received. Analysis of both wing-tag and satellite data indicate the relative importance of human derived food resources for gulls in Massachusetts. Casual and directed feeding by people at various parking lots has been identified as a main source of food for gulls. In addition, gulls use of waste water treatment facilities as a food source has been documented. Based on information gained, proposed management recommendations will try and reduce or eliminate food resources in specific parking lots through signage and education. In addition, efforts to prevent gulls from utilizing waste water treatment plants will be made. Continued monitoring will assess the impact of reduced food availability on the gulls' presence and use of DCR water supply reservoirs.

Acknowledgements

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Introduction

In the early 1990s, the Department of Conservation and Recreation, Division of Water Supply Protection (Division) recognized a strong correlation between increasing numbers of gulls and other waterfowl at Wachusett and Quabbin Reservoirs and an increase in fecal coliform concentrations from water samples taken at each intake structure. As a result, the Division implemented a bird harassment program in 1993. Since then, the harassment program has been effective in maintaining source water quality standards by excluding gulls from roosting in critical areas around the intake structures. While the program has been able to successfully exclude roosting birds, it does have its limitations. The program requires a substantial investment of time and resources, is conducted during the fall and winter under sometimes hazardous conditions, and does not exclude gulls from roosting on other parts of the reservoir.

While an extensive amount of resources were being expended each year in the harassment program, very little basic information about the gulls was known. As a result, a research program was initiated in January 2008 to study gulls in central Massachusetts. Specifically, the following research questions were posed:

1. What and where are the seasonal food resources for each gull species?
2. What are the movement patterns between feeding, loafing and roosting sites? Do they move between the DCR water supply reservoirs and "alternate roosts"?
3. What are the population dynamics of gulls in Massachusetts?
   a. Where do they nest?
   b. What are the sources of mortality?
   c. What is their lifespan?
4. Can we gain enough information to influence how many gulls are utilizing the reservoirs?

This report presents a summary of activities from 2008-2010. Initially, the study was focused on three species of gulls known to utilize the reservoirs: ring-billed, herring, and great black-back. As the study progressed, it became clear that ring-billed gulls were the most prevalent gull in central Massachusetts and were the most common gulls utilizing the reservoirs. In addition, a vast majority of the data collected to date are from ring-billed gulls. Based on the limited amount of data collected from herring gulls, and even less from black-back gulls, this report (and this study) focuses almost exclusively on ring-billed gulls.

At this time, a limited amount of satellite movement data has been analyzed. All wing-tag sighting information is up to date, as well as trapping results. In addition to reporting on last season's progress, this report will also introduces ideas and actions for the next phase of the project where information learned through the study will be applied in the field.

Results

Trapping

Trapping efforts during this field season began in October 2009 and continued until March 2010 and were conducted opportunistically 1-3 times/week (Figure 1). The net launcher was used exclusively for capture. A variety of capture locations were utilized, including the shoreline of Wachusett Reservoir (Figure 2). To date, close to 900 gulls have been captured (Table 1).

Photo by Jillian Pereira

Figure 1. Trapping at Searstown Mall, Leominster, MA 3/16/10

Table 1. Summary of Trapping Efforts, January 2008 - March, 2010

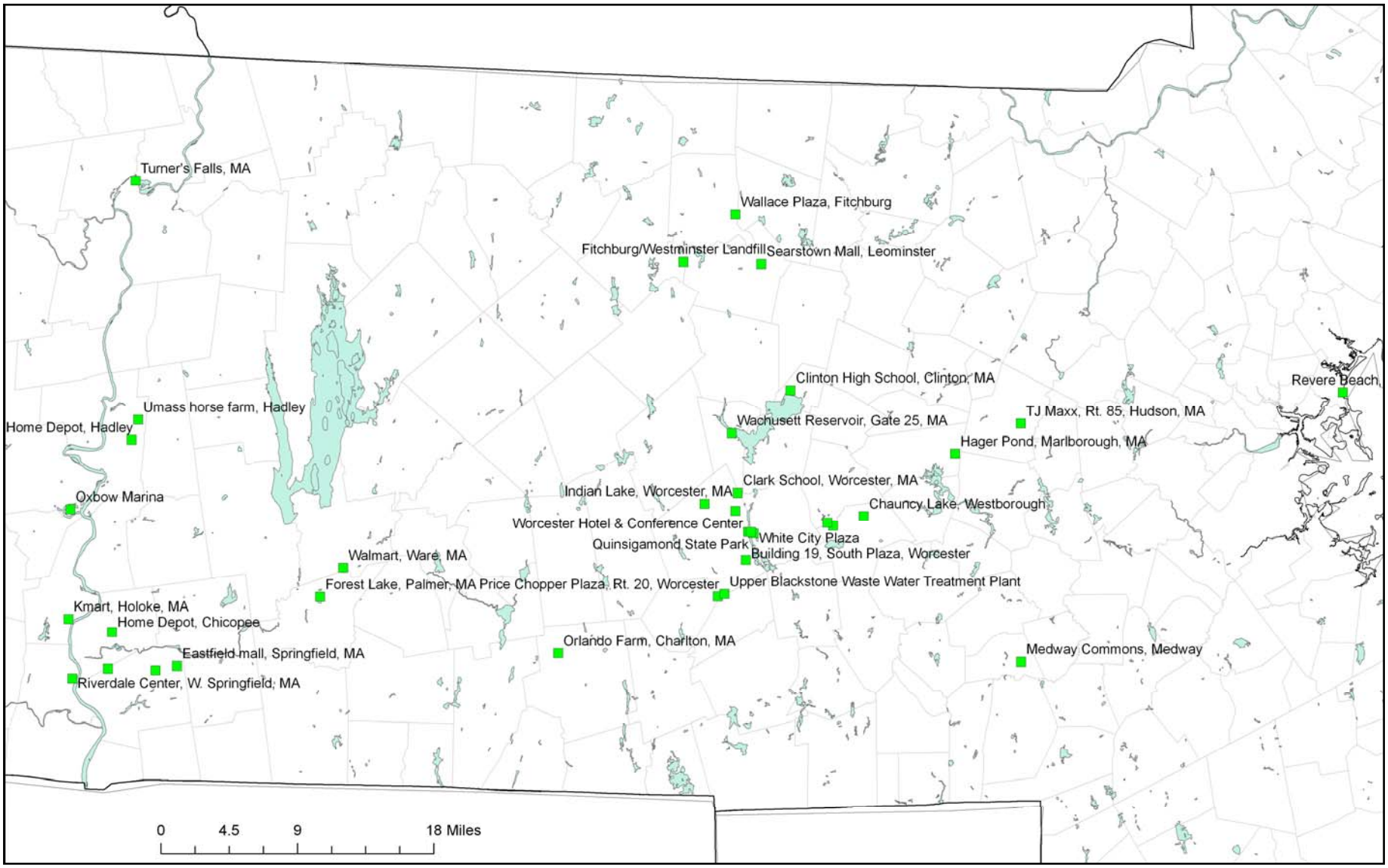
Reservoir	Ring-billed	Herring	Black-back	**Total**
Wachusett	484	84	18	586
Quabbin	276	13	1	290
Total	760	97	19	**876**

Photo by Robert Kirby

Figure 3. Ring-billed Gull Fitted with Leg Bands and Wing-tags

Following capture, all birds were fitted with an aluminum federal leg band. A uniquely numbered colored leg band was placed on the opposite leg of most birds (Figure 3). Finally, on most birds, a colored, uniquely numbered wing-tag was attached to each wing (Figure 3). These wing-tags made identification from a distance possible, particularly when seeing or reading the leg bands was difficult. Wing-tags were color-coded based on a capture site's proximity to either Wachusett or Quabbin Reservoir. Wing-tags were secured to the birds with a single rivet attached through the patagium.

Figure 2. Capture Sites Used During Gull Study, 2008-2010



On a small number of gulls, satellite transmitters were attached instead of wing-tags. Transmitters were attached using a backpack harness. Teflon tape backpack harnesses were fitted snugly on the bird and sew into place using a combination of abrasion resistant fishing line and quick set glue (Figure 4). Five different types of transmitters were deployed. A 45-gram GPS equipped transmitter was deployed on the adult great black-back gull. Two 30-gram and four 22-gram GPS equipped transmitters were deployed on adult herring gulls. In addition, three 20-gram non-GPS equipped satellite transmitters were deployed on herring gulls. The ring-billed gulls received 9.5-gram non-GPS equipped satellite transmitters from two different manufacturers. All transmitters were solar-powered and have the potential to last several years.

Photo by Ken MacKenzie

Figure 4. Adult Herring Gull Fitted with a 30-gram Solar GPS Transmitter

Wing-tag Sightings

From February 2008 until May 2010, 2,420 sightings were reported of wing-tagged or leg banded birds captured during our study. A majority of the sightings were reported from the public, either through avid birders or casual observers. Sightings have covered an extensive geographic area and ranged from Canada to Georgia (Table 2; Figures 5 and 6). Not surprisingly, a vast majority of these sightings were of tagged ring-billed gulls. However, close to 30 herring and 20 great black-back gulls have been sighted. In addition, several gulls have been sighted that have been tagged for 12+ months.

Table 2. Locations of Reported Wing-tagged Gulls, February 2008 - May 2010

State/Province	# Birds Seen
Massachusetts	1,637
Connecticut	277
New York	72
Rhode Island	71
Maine	63
Newfoundland	58
Quebec	35
New Jersey	34
New Hampshire	30
New Brunswick	29
Vermont	20
Pennsylvania	17
Maryland	17
Delaware	15
Virginia	10
Prince Edward Island	9
Nova Scotia	8
Ontario	6
North Carolina	5
South Carolina	2
Labrador	2
Georgia	2
Manitoba	1

In Massachusetts, gulls have been sighted from the Connecticut River east. A majority of the sightings have been in central Massachusetts, and to date, no birds have been seen in Massachusetts to the west of the Connecticut river or on Cape Cod (except for one suspect sighting that is included). Tagged gulls have been seen in a variety of locations, although most birds are sighted in association with food or water (Table 3).

Table 3. Summary of Sighted Wing-tagged Birds, February 2008 - May 2010

Location of Sighting	Total Number of Birds Seen
Parking Lot	773
Fresh water	550
Salt water	326
Roosting on DCR reservoirs	289
Roosting on other water bodies	27
Fields	170
Parks	75
Waste water treatment plant	31
Landfill	25
Breeding	19
Unknown	48

Figure 5. Locations of Sighted Wing-tagged Gulls, February 2008-May 2010

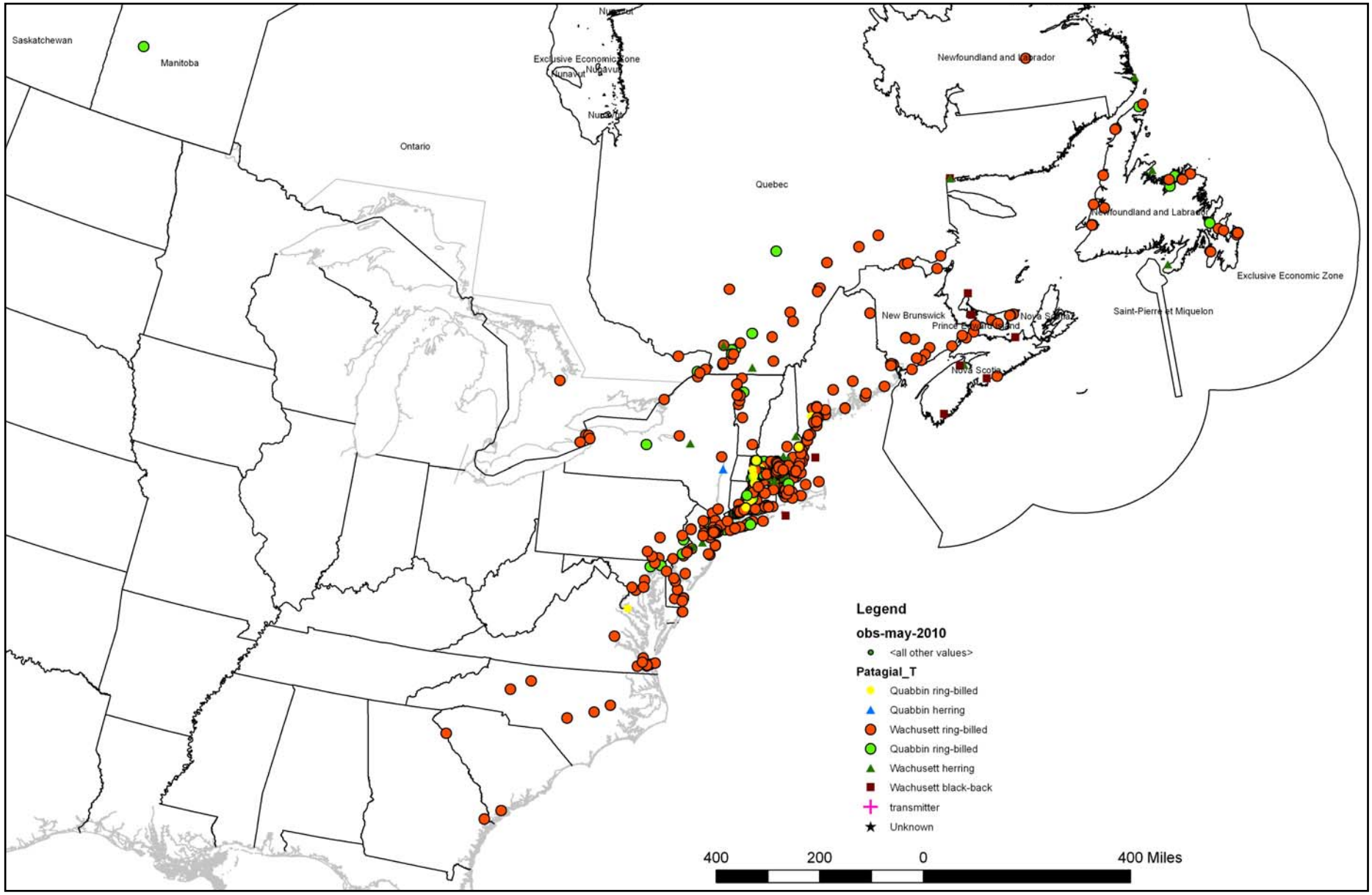
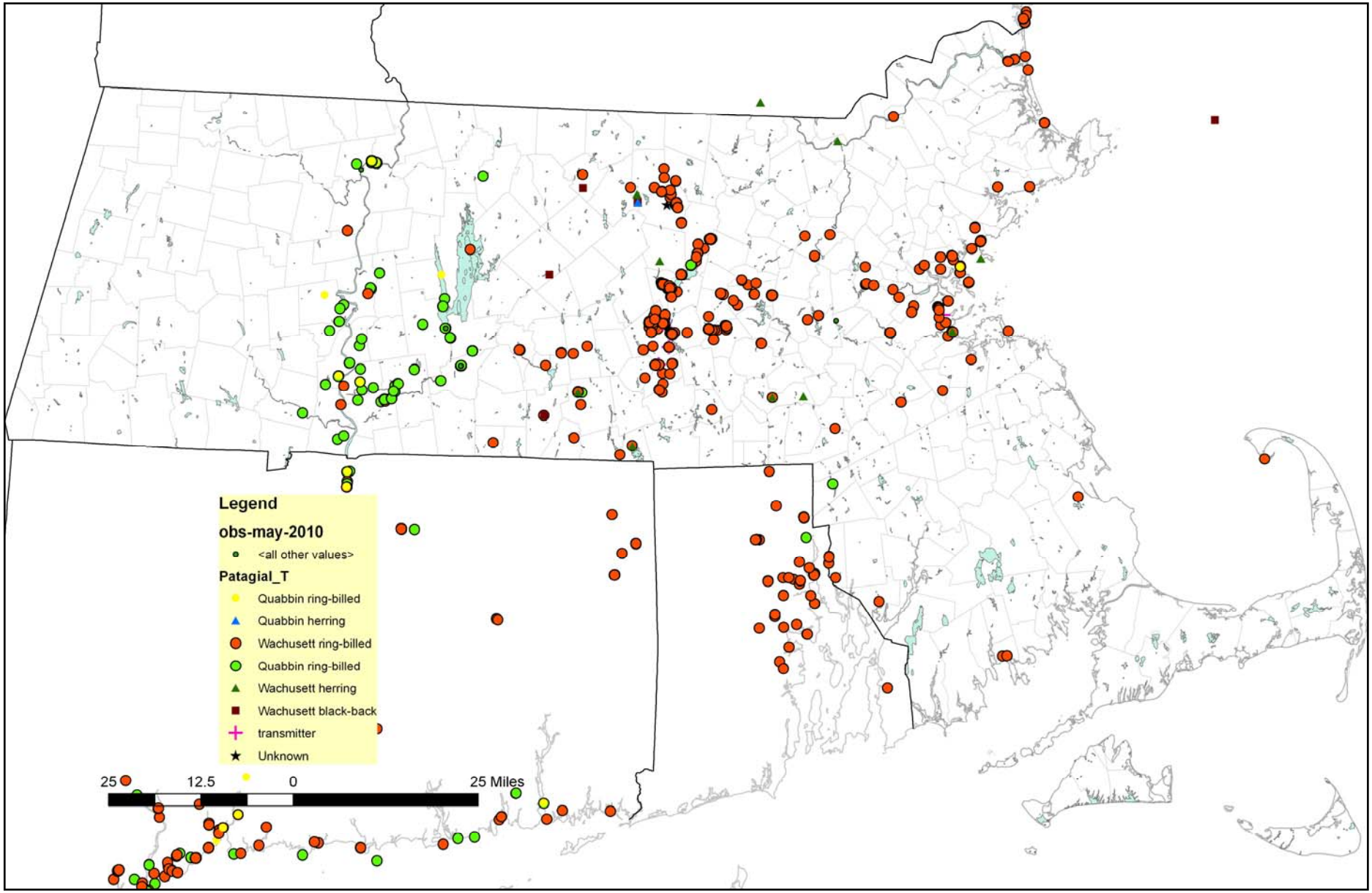


Figure 6. Locations of Sighted Wing-tagged Gulls within Massachusetts, February 2008-May 2010



Habitat Use

Of the approximately 2,400 sightings to date, roughly 30% of them have occurred in parking lots. Gulls (primarly ring-billed) use parking lots throughout Massachusetts but also use parking lots throughout their range. In total, 554 sightings of gulls were recorded in parking lots in Massachusetts. A majority of these sightings (531) were within central Massachusetts (defined as within 20 miles of each reservoir). More specifically, seven parking lots (one near Springfield and six in greater Worcester) accounted for 74% (393 of the 531) of all sightings. These seven parking lots, including the Walmart parking lot in Northborough, White City Plaza in Shrewsbury, and Lincoln Plaza in Worcester consistently had high numbers of gulls, both marked and unmarked. While many of the sightings in these 7 parking lots were recorded by NR staff, they reflect the overall abundance of gulls in these areas. During the course of trapping or routine monitoring, NR staff travelled extensively throughout central MA visiting a variety of parking lots in search of tagged gulls and also concentrations of gulls for use as future capture sites. In general, these 7 parking lots (and a few others with lower numbers) were the most frequently used lots within 20 miles of the Reservoirs.

Waste water treatment plants were used consistently by gulls in Massachusetts and throughout their range. While we had a fewer number of total sightings at treatment plants (31) compared to parking lots, these facilities represent a consistent source of food for gulls. Tagged gulls (and large numbers of untagged gulls) were sighted at the Upper Blackstone Water Abatement Plant, Webster Wastewater Treatment Plant, Veolia Water Treatement Plant in Leominster, and the Newburyport Water Treatment Plant. In addition, tagged gulls were seen at waste water treatment plants in New Hampshire, New York, Pennsylvania, and New Brunswick. Although there is open water year-round at waste water treatment plants, our sightings indicated that these areas were being used as a food source, not a source of open water to loaf and/or preen. Observations of gulls at these sights were made throughout the field season, and in each case when gulls were in contact with any water, they were feeding.

Reservoir Use

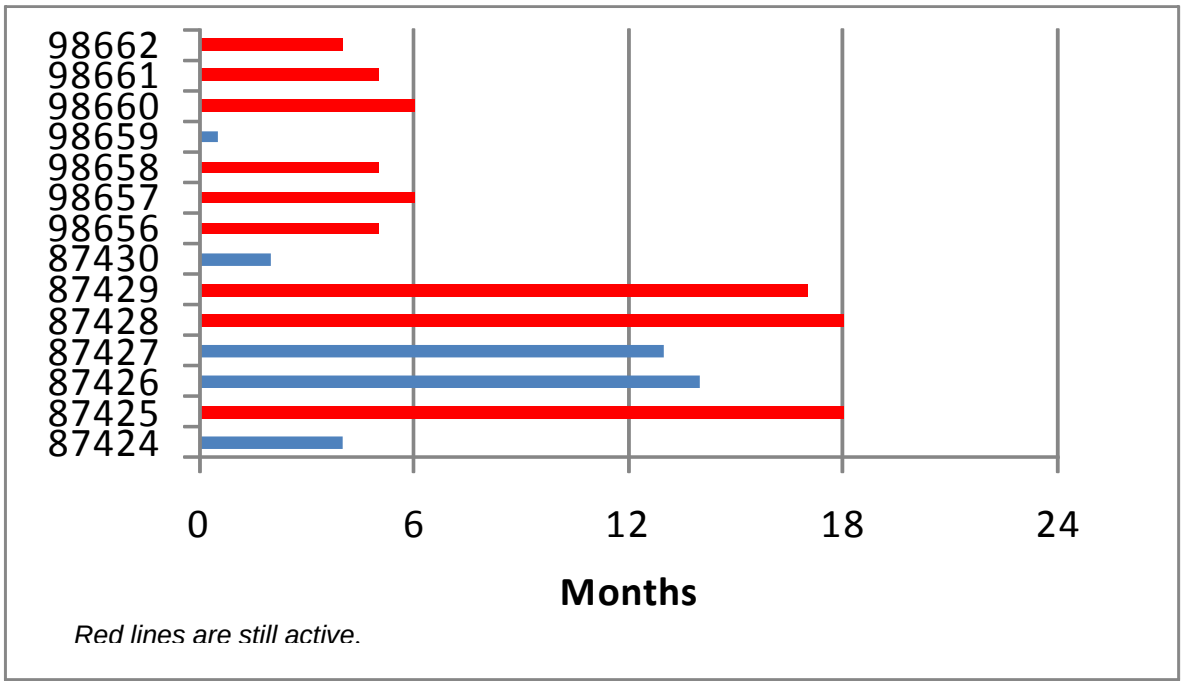
From March 2008 until May 2010, 289 (284 ring-billed and four herring) sightings of wing-tagged birds were recorded roosting on Wachusett Reservoir. In addtion, 14 wing-tagged gulls have been observed loafing during the day at Wachusett Reservoir, and three gulls at Quabbin. While most of the wing-tagged birds were too far away to positively identify the number on the tag, we were able to determine 55 different individuals using the reservoir. Along with Wachusett and Quabbin Reservoirs, other water bodies harbored wing-tagged roosting gulls, including: Barton Cove in Turner's Falls, MA, Indian Lake, Worcester, and Lake Cochituate in Framingham.

Satellite Data

To date, 28 satellite transmitters have been deployed. Transmitters have operated for as little as one month to over two years (Figures 7 and 8). Of the 21 transmitters that were deployed over a year ago, 12 have provided at least 12 months worth of movement data. Close to 40,000 location points have been collected from satelitte-equipped birds. However, of the 40,000

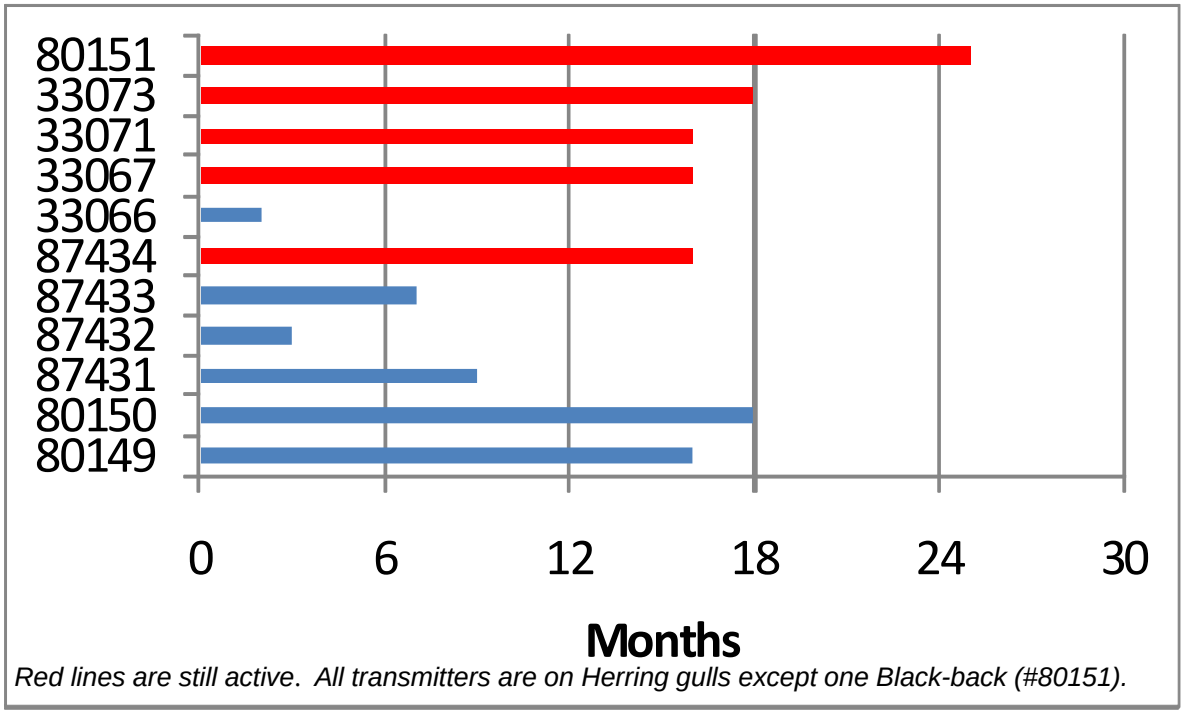
points, approximately half (~21,000) are high enough quality to be used in analysis (Table 4). Differences in transmitter manufacturer and size influence what percent of the locations are usuable. Smaller units tend to have a lower percentage of quality locations, most likely related to the smaller solar panels and internal batteries.

Figure 7: Longevitiy of Transmitters Deployed on Ring-billed Gulls



Red lines are still active.

Figure 8. Longevity of Transmitters Deployed on Herring and Black-back Gulls



Red lines are still active. All transmitters are on Herring gulls except one Black-back (#80151).

Table 4. Satellite Locations Collected for Each Model of Transmitter, February 2008 - April 2010

Transmitter*	# Locations received	# Locations usuable[1]	Percent usable
Northstar 12g (7)	7,921	3,071	38.77
Microwave 30g(2)	6,045	6,045	100
Microwave 45g(1)	3,030	3,030	100
Microwave 9.5g(7)	11,893	3,355	28.21
Microwave 22g(4)	6,262	5,258	83.97
Northstar 9.5g(7)	3,432	409	11.92
TOTAL	38,583	21,168	54.86

*(# of transmitters of each type)

[1] Locations were graded for accuracy using a scale of Z, A, B, 0, 1, 2, 3, with 3 being the most accurate. Usable locations were points with accuracy of 1, 2, or 3; all other points were considered too inacurate to be usable.

Currently, there are 13 satellite transmitters still active (Table 5). Three Microwave 22g transmitters failed prematurely due to a manufacturing default. Fortunately, Microwave replaced these units at no cost. In addition, several other transmitters stopped transmitting suddently. All previous data from these units were normal. It is possible that these units failed prematurely, the bird died suddenly, or the unit stopped transmitting temporarily due to weather or bird behavior. We have experienced the temporary "loss" of transmitters previously, and in these cases, the transmitter came back onto the air after several weeks of no activity.

Table 5. Summary of Deployed Satellite Transmitters

Transmitter #	Species	Date Deployed	Still Active	GPS capable	Fate
87424	Ring-billed	11/17/2008	NO	NO	DEAD
87425	Ring-billed	11/10/2008	YES	NO	-
87426	Ring-billed	11/5/2008	NO	NO	OFF AIR[a]
87427	Ring-billed	10/29/2008	NO	NO	OFF AIR
87428	Ring-billed	11/10/2008	YES	NO	-
87429	Ring-billed	12/4/2008	YES	NO	-
87430	Ring-billed	11/12/2008	NO	NO	DEAD
98656	Ring-billed	12/7/2009	YES	NO	-
98657	Ring-billed	11/18/2009	YES	NO	-
98658	Ring-billed	12/1/2009	YES	NO	-
98659	Ring-billed	12/15/2009	NO	NO	OFF AIR
98660	Ring-billed	11/12/2009	YES	NO	-
98661	Ring-billed	11/9/2009	NO	NO	OFF AIR
98662	Ring-billed	1/5/2010	YES	NO	-
80149	Herring	3/11/2008	NO	YES	DEAD
80150	Herring	2/8/2008	NO	YES	DEAD
80151	Black-back	3/27/2008	YES	YES	-
87431	Herring	10/9/2008	NO	YES	FAILURE[b]
87432	Herring	1/21/2009	NO	YES	FAILURE
87433	Herring	11/5/2008	NO	YES	FAILURE
87434	Herring	1/20/2009	YES	YES	-
33066	Herring	3/27/2008	NO	NO	DEAD
33067	Herring	1/21/2009	YES	NO	-
33071	Herring	1/27/2009	YES	NO	-
33073	Herring	11/5/2008	YES	NO	-

[a] Bird stopped transmitting suddenly; previous data were normal; fate unknown
[b] Transmitter failed prematurely; bird presumed to be alive

Individual Analysis: Ring-billed Gull 87428

Although most satellite data still needs to be categorized and processed, one individual has been completed. Ring-billed gull 87428 was captured on 11/10/2008 at Searstown Mall in Leominster, MA. At present, this gull is still alive and transmitting data. To date, 2,720 locations were received for this bird, and 738 (27%) were usable in analysis. Of the 738 locations, 296 were transmitted during the day (defined as between 07:00 and 20:00) and 442 at night. The 738 locations represent data from 258 different days. The number of locations received on any given day ranged from one to nine.

Habitat Use

Similar to the wing-tag data, gull 87428 spent most of its time associated with water or feeding locations (Table 6).

Table 6. Gull 87428 Habitat Locations

Habitat	Total Number of Locations
Roosting (fresh water)	268
Breeding	92
Loafing (fresh water)	73
Parking lot	56
Field	51
Roosting (salt water)	51
Loafing (salt water)	12
Landfill	6
Park	6
Waste Water Treatment Plant	3
Urban/Flying/Other	113

Gull 87428 was located in parking lots primarily during the late fall and winter and use of fields was limited to the early spring. As shown with other data, this gull also utilized waste water treatment plants, landfills, and parks as a source of food, although much less frequently than parking lots. Within central Massachusetts, 87428 utilized many of the same parking lots that were frequented by wing-tagged gulls, including some of the seven main parking lots in the area.

Roosting

Gull 87428 utilized a variety of locations for roosting, including both fresh and salt water (Table 7). However, when in Massachusetts, this gull used only two fresh water roosting sites, and Wachusett Reservoir was used predominantly, primarily from October to December each year. The 119 locations on Wachusett Reservoir represented 46 different days the bird was present. In addition, the gull was documented loafing during the day at Wachusett on three different days.

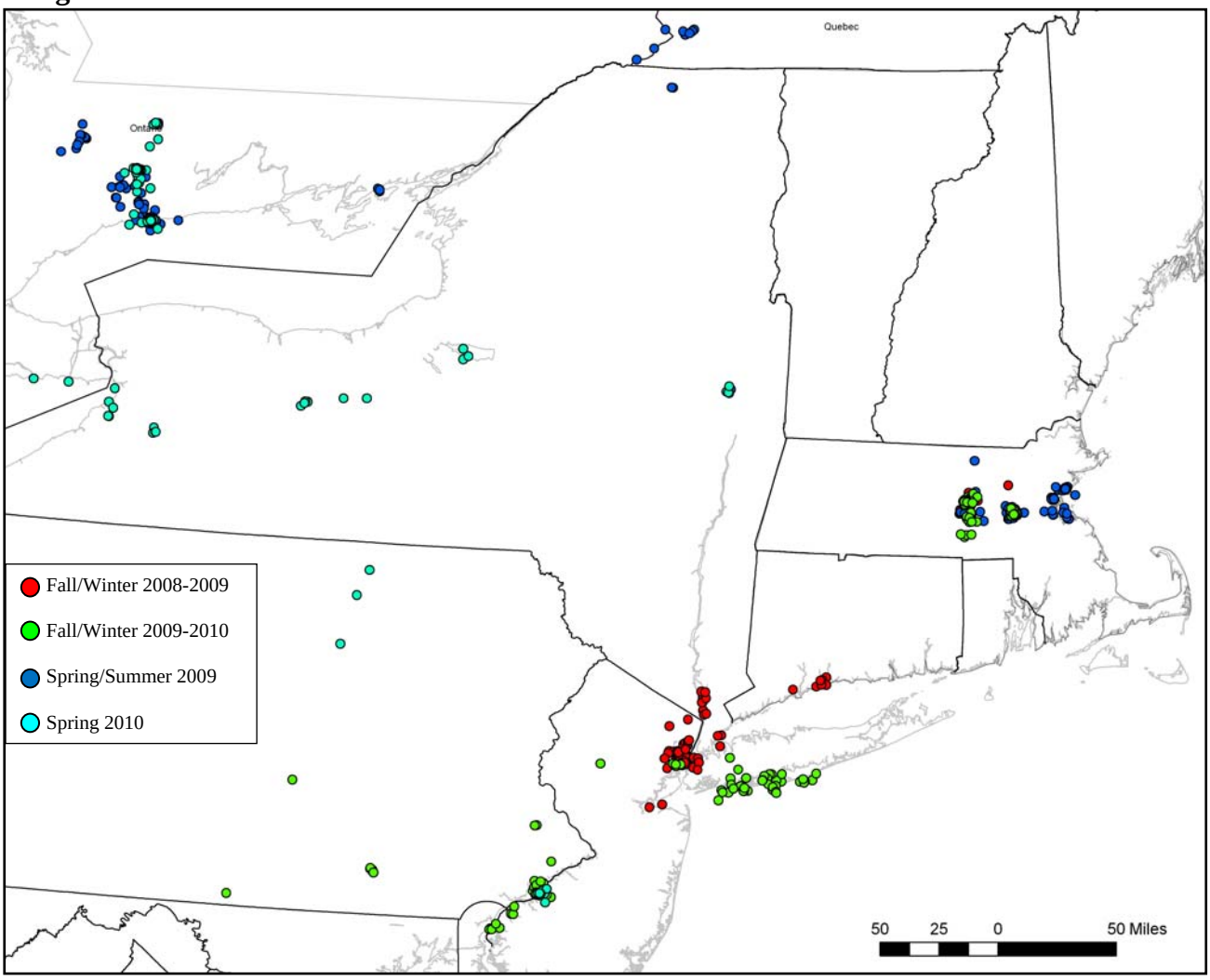
Table 7. Gull 87428 Roosting Locations

Body of Water	Location	Total Number of Data Points
Wachusett Reservoir	Boylston, MA	119
Lake Cochituate	Natick, MA	64
Delaware River	DE, NJ, PA	33
Lake Scugog	Ontario	20
Hackensack River	NJ	15
Ocean	Off Long Island	27
Long Island Sound	NY	5
Coastal MA	Off Revere, Lynn Beach	13

Seasonal Movements

During two seasons of data, 87428 displayed a very consistent pattern of movement and habitat use (Figure 9). Gull 87428 was captured and banded on 11/10/08. The gull stayed in Massachusetts until 12/20/08 when it flew south to New York. It stayed in and around New York/New Jersey until 3/10/09 when it flew north for a short stay in Massachusetts before continuing north. It arrived at its breeding grounds at the Bowmanville Cement Works on the shores of Lake Ontario (a known breeding colony) on 4/24/09. 87428 returned to Massachusetts on 7/7/09 and stayed in and around central and coastal Massachusetts until 12/20/09, when it flew south again to New York. It stayed in the New York, New Jersey, Pennsylvania area until 3/20/10, when it flew north, bypassing Massachusetts. It arrived at the breeding colony on 4/27/10.

Figure 9. Gull 87428 Seasonal Movements

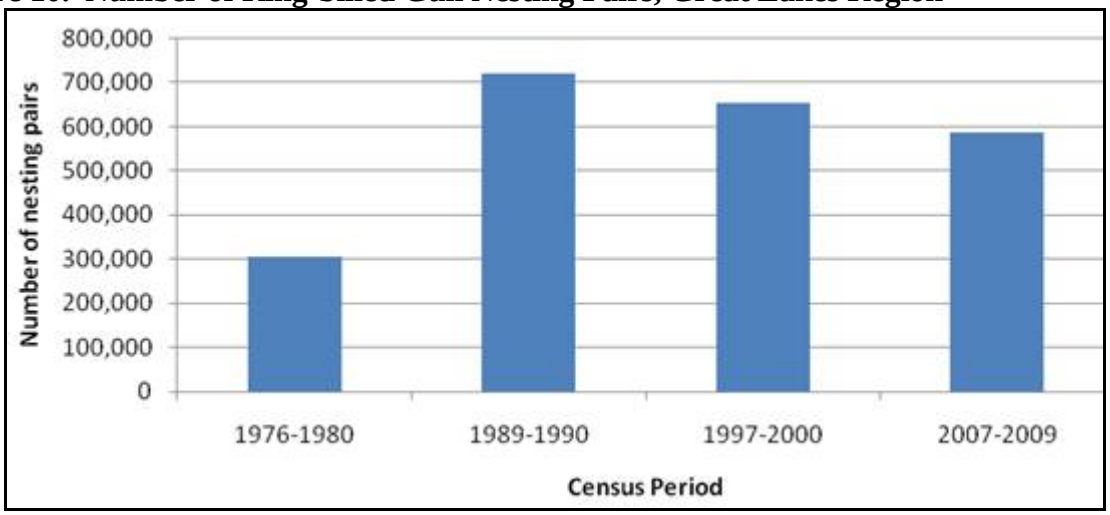


Regional Population Trends of Ring-billed Gulls

Wing-tagged and satellite tagged gulls from this study have been documented breeding in two locations: the Great Lakes region (including the St. Lawrence seaway) and Lake Champlain. Routine censuses are conducted on foot by researchers surveying the whole colony. While there have been a number of sightings of gulls from Newfoundland, New Brunswick, and Nova Scotia, there has not been any breeding documented in those locations. However, breeding censuses in those areas are done aerially, so there is little chance of spotting a tagged gull. It is likely that a majority of ring-billed gulls located in Massachusetts breed either in the Great Lakes or Lake Champlain.

Regular censuses take place at both locations[1], and at both sites, ring-billed gulls have the distinction of being the most abundant colonial nesting waterbird. However, this distinction has occurred relatively recently. Ring-billed gulls were rare or almost absent from both locations as recently as 1920-1950. Both breeding locations experienced tremendous growth during the 1970s and 1980s. At its peak, the Great Lakes supported roughly 700,000 pairs of nesting ring-billed gulls (Figure 10). While numbers have declined since that peak, there are still a tremendous number of ring-billed gulls nesting throughout that region.

Figure 10. Number of Ring-billed Gull Nesting Pairs, Great Lakes Region



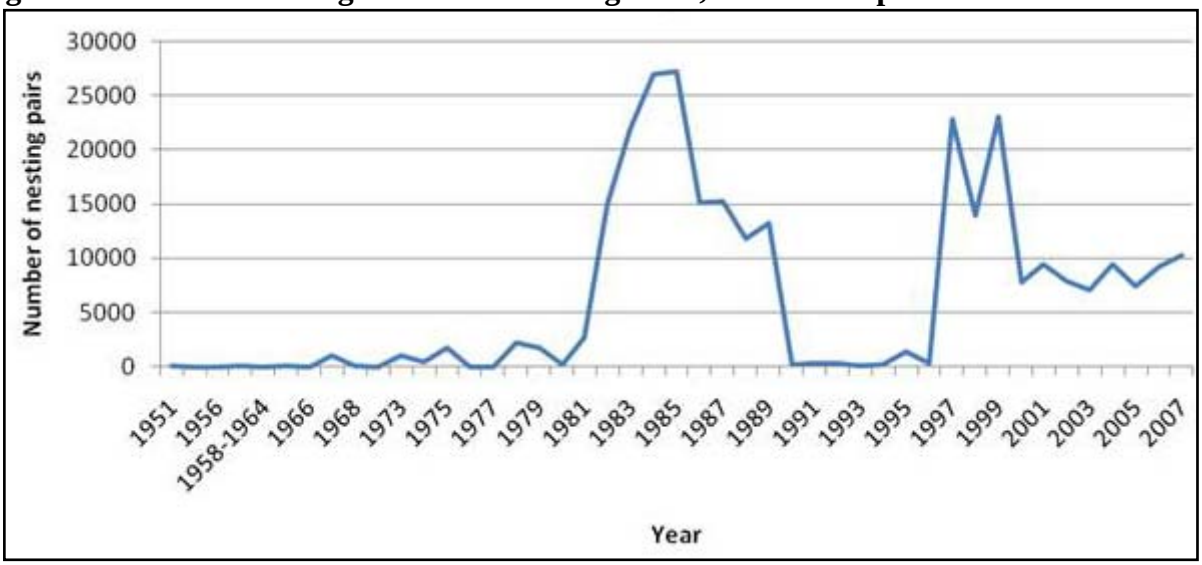
Ring-billed nesting on Lake Champlain followed a similar trajectory (Figure 11), although the overall numbers are much lower. Essentially absent from the lake in the 1950s, ring-billed gulls populations increased dramatically during the 1980's and have since declined.

There are population control programs in place at both locations at a limited scale. Control operations often result in substantial declines in reproduction or whole colonies being elminated or deserted. However, most control efforts are focused on specific breeding colonies where competing interests (including rare species, air traffic safety, and proximity to urban areas) take

[1] Morris, Ralph D. et al. *Population Trends of Ring-billed Gulls Breeding on the North American Great Lakes, 1976 to 2009* in press and Vermont Audubon; Dave Capen, pers. comm.

precendence. As a result, most efforts affect only a small percentage of the total breeding population.

Figure 11. Number of Ring-billed Gull Nesting Pairs, Lake Champlain



Preliminary Conclusions

Pre-study Understanding of Gull Behavior

While the Division has been actively monitoring and harassing gulls at each reservoir for many years, very little basic life history or behavioral information of gulls was known. The Division knew that during the fall and winter, gull numbers at the reservoirs increased dramatically and typically reached a peak when other lakes and reservoirs within central Massachusetts froze, but Wachusett and Quabbin Reservoirs remained open. While gulls were often anecdotally noted at various locations, including landfills and parking lots, it was unclear how, when, and specifically where they were obtaining food. In addition, it was unclear to what extent the reservoirs were being used by roosting and loafing gulls and whether other water bodies were also utilized. In addition, it was hypothesized that specific gulls travelled to central Massachusetts during the non-breeding season and then remained in the area for the winter (wintering population). As spring arrived, it was assumed this wintering population then travelled back to the breeding grounds.

Prior to the initiation of this study, casual observations and anecdotal evidence suggested that landfills played a substantial role in attracting and maintaining gull populations in central Massachusetts. Gulls (though specific species weren't noted) were routinely seen at landfills, and flight patterns suggested that gulls feeding at area landfills often made their way to Division reservoirs for roosting. When DEP enacted landfill regulations aimed at preventing gulls from feeding, a noticeable decline in gull presence was seen at most monitored landfills, but gull numbers at each reservoir remained high.

Insights and Knowledge Gained Through the Study

This study has enabled the Division to mark individual gulls and track them both spatially and temporally. By being able to identify individual gulls (through wing-tags and satellite tags), the Division has gained tremendous insights into the movements, feeding behavior, reservoir use, and seasonal patterns of gulls found in central Massachusetts. Specifically, the Division has learned:

1. The study has provided a tremendous amount of data related to Wachusett Reservoir and its use. Comparatively little data have been collected on Quabbin Reservoir – gull use of this water body seems much more inconsistent and was utilized by very few tagged gulls. In addition, viewing wing-tagged gulls at Quabbin is extremely difficult. As a result, early conclusions apply primarily to Wachusett.
2. Ring-billed gulls are the main gull species utilizing the reservoir. On most nights, ring-billed gulls constitute at least 75% of the roost. While herring gulls and great black-back can be found roosting on the reservoir, their numbers are much lower and their presence much less consistent.
3. Ring-billed gulls in central Massachusetts rely almost exclusively on human-derived sources of food, including parking lot handouts and waste water treatment facilities (but not landfills).
4. Not all parking lots are equal. Certain parking lots in central MA are used frequently by ring-billed gulls and consistently attract the largest number of gulls because of the type and amount of food available and the physical characteristics of the lot (see next section on Parking Lots).
5. Waste water treatment plants within central MA are used by ring-billed (and some herring) gulls as a source of food. Gulls utilize these areas most often during the fall and early winter and will feed at various points within the plants (i.e. raw water inflow, settling ponds, etc.). Gulls utilizing these treatment plants will roost on Wachusett reservoir.
6. Ring-billed gulls will utilize other water bodies within central MA for both roosting and loafing. However, Wachusett Reservoir seems to be used by all gulls at some point during the non-breeding season.
7. Most gulls that arrive in central MA during the non-breeding season do not stay in the area for the whole winter. Almost without exception, tagged individuals caught in central MA continued south at some point during the winter. Tagged individuals returning to Massachusetts the following fall again left Massachusetts at some point during the winter. How far south each gull travelled varied greatly. Some individuals drifted to Connecticut and Rhode Island, while others traveled as far south as Florida. However, even though gulls continued to move south during winter, there were always gulls present in central MA. Gulls shifting south were (mostly) replaced by gulls further north shifting south also. Gulls from the north drifted south into Massachusetts throughout the winter.
8. Gulls utilizing central MA during the non-breeding season travelled to breeding colonies in either the Great Lakes, Lake Champlain, or the St. Lawrence seaway.
9. While gulls moved extensively up and down the eastern seaboard, no gull travelled further west than the western edge of Lake Huron.

Proposed Management Recommendations: Landscape Level Management

The field research portion of the study has been tremendously successful at catching, tagging, and repeatedly sighting a large number of individual gulls. Information gained from the wing-tagging program and satellite transmitters has enabled the Division to determine specific feeding locations, identify sources of food, document roosting behavior, and characterize seasonal movement patterns. Taken together, this information can be used to develop a management plan to try and reduce or eliminate the presence of gulls at each water supply reservoir. While such a goal is daunting, it is reasonable to believe that information gained through this research can be applied in the field with some expectation of success.

A landscape level approach to managing gull populations in central Massachusetts is necessary because of their documented mobility and ability to find and exploit food sources and roosting locations. The primary target for the landscape level control will be reducing or eliminating the main sources of food for gulls that utilize the reservoirs. A proposed time line for management activities is shown in Table 8.

Controlling Food Sources

The behavior of most wildlife is greatly influenced by the search and consumption of food. Ring-billed gulls in central Massachusetts during the non-breeding season displayed a very consistent pattern of movement and locations. Human derived food resources were used throughout the fall and winter and were occasionally supplemented by natural food (almost exclusively worms in fields). Because gulls obtained a majority of their food from humans, it is possible to eliminate or greatly reduce that source through a variety of targeted approaches.

Parking Lots

Quality ring-billed gull parking lots are characterized by a number of unique features. The most frequently used parking lots tend to be large and open with a substantial amount of area dedicated to parking spaces. These lots most often have multiple light poles scattered throughout the lot which serve as loafing sites. In addition, these high use parking lots have few overhead obstructions (wires, etc.) or closely constructed buildings thereby allowing gulls to freely move between the ground and perching sites on light poles or adjacent roof tops. Very rarely will gulls utilize smaller, constricted parking lots where it is difficult to land on the ground because of the limited amount of open parking space or closely constructed buildings. In many cases, these high use lots will contain restaurants or fast food chains. Finally, and most importantly, these high use lots have a history of consistent availability of human food, either through casual feeding (i.e., dropping a few French fries out the window), or dedicated feeding (i.e., regular visitors bringing large bags full of food to leave for the birds). Because the gulls at these lots are obtaining food exclusively from humans, there is an opportunity to reduce or eliminate that food source through a dedicated effort. To be the most effective, this approach must: 1.) Be done at all high use parking lots; and 2.) Include most or all of the following actions:

1. **Education**

   People provide food to a variety of wildlife species- most notable are birds. With respect to this study, there are people who regularly feed gulls, either opportunistically (while eating lunch and dropping a few scraps), or purposefully (buying and bringing food to a parking lot on a regular basis). During routine trapping and observations, we have observed many feeding events. In many cases, it is the dedicated feeder that provides the most abundant and reliable source of food. On occasions when these people were approached, they indicated that they felt they were helping the gulls during a difficult time of year. In every interaction, the feeder had no idea where and why the gull went each night. Many believed the gull stayed in the parking lot all night. When the feeder was told that most gulls made their way to a water supply reservoir each night, they were surprised, and in most cases, even after only 1 conversation, they said that based on this new information, they would cease feeding gulls. In reality, educating the public on the connection between clean water and feeding gulls in parking lots will be more challenging, but possible.

   To initiate this education, a single parking lot will be selected as a pilot program. The Division, assisted by a graduate student from Antioch College, will determine the best approach and then apply that technique to the remaining parking lots. Consistent on the ground interactions will be conducted to target both dedicated and casual feeders. Seasonal field staff would be helpful to provide this level of interaction.

2. **Signage**

   Educational signage will be used in conjunction with on the ground interactions between DCR staff and public feeders. Large, easily observed signs in each parking lot will be posted that clearly explains the connection between feeding a gull and water quality. Signs will be easy to read and strategically placed to optimize their effectiveness. In addition, smaller versions of the sign can be made and handed out during public interactions.

3. **Physical Exclusion**

   While eliminating the source of food in these parking lots will be the ultimate goal, it may be helpful to couple these efforts with methods to physically exclude gulls from parking lots. There are several published studies[2] that suggest that gulls can be excluded from discrete areas through the use of overhead wires. These wires are often strung in a grid pattern and provide a physical and/or psychological barrier to gulls. Gulls are very reluctant to fly through or near perceived physical barriers. In certain parking lots, wires could be strung between light poles creating a grid pattern that would provide a barrier, preventing the gulls from landing in the lot.

[2] Blokpoel, H. and Tessier, G. D. 1984. *Overhead Wires and Monofilament Lines Exclude Ring-billed Gulls from Public Places*. Wildl. Soc. Bull. 12: 55-58; Belant, J. L. and Ickes, S. K. 1996. *Overhead Wires Reduce Roof Nesting by Ring-billed Gulls and Herring Gulls*. Proc. Vertebr. Pest Conf. 17: 112-116.

4. **Owner Cooperation**
   All of these high-use parking lots are privately owned, so owner cooperation is critical. In almost all cases, owners have allowed us to trap and tag gulls on their property. In many instances, owners expressed frustration and dislike for the gulls. Cooperation (and ideally cost-sharing) would be needed for the placement of signs and wires, where appropriate. In addition, cooperation would also be critical to ensure that employees encourage the public to follow the no-feeding policy.

5. **Community Participation**
   There is no law in Massachusetts against feeding wildlife. However, local boards of health in each town have the ability to issue ordinances against activities that are detrimental to their community. While we are hopeful that education can ultimately achieve these goals, it may be necessary to approach local towns for their assistance in passing a "no gull feeding" ordinance to reinforce DCR's efforts.

6. **Monitoring**
   Monitoring is a critical component of this management plan. Monitoring and measurements of success will be determined several ways. First, parking lots will be monitored for the presence of gulls. In addition, the wing-tagged and satellite tagged gulls can be used to aid in determining how gulls respond to a locally reduced food supply. Gull numbers will be closely monitored at the reservoirs through roost counts and daily harassment observations.

Wastewater Treatment Plants

During the course of this study, it was discovered that gulls utilize waste water treatment plants during the day then return to the reservoirs to roost at night. Gulls utilize these plants most often during the fall and winter and will use plants throughout their range. In central Massachusetts, there are only a small handful of plants that are used consistently by gulls. In all cases, gulls are present at the plants to feed, either finding food in the incoming untreated water, or at various stages of settling or treatment.

1. **Physical Exclusion**
   Because there is no human element at these sites, control efforts should be more straightforward. At each waste water treatment plant in central Massachusetts, modifications to the plant could be made to physically exclude the gulls from the untreated and partially treated water. Carefully placed wires could be installed to exclude gulls from all open water at the plants and still allow operations to continue. A variety of wire placements could be used to optimize their effectiveness and minimize their impact on operations.

2. **Owner Cooperation**
   Owner cooperation is critical. The placing of exclusion wire would have to be coordinated with the facility operators, and they would have to agree to participate in the effort. However, the installation of these wires could be done in a way that still allows adequate access but prevents the gulls from landing and feeding on the water.

3. **Monitoring**
   As with the parking lots, waste water treatment plants would be monitored for the presence of gulls before and after the control program.

Landfills

Early in the study, a good deal of time was spent at area landfills. In some cases, gulls were allowed to feed almost undisturbed, and as a result gull numbers were tremendously high. In all cases, however, the only gulls present at these landfills were herring and great black-back gulls. With the exception of one sighting, no ring-billed gulls were ever seen feeding or loafing at a landfill in Massachusetts. Fortunately, DEP regulations enacted in 1998 prevent landfill operators from allowing gulls to feed on the active face. The enforcement of these regulations should be encouraged, and area landfills should continue to be monitored.

1. **Harassment**
   The closest landfill to Wachusett Reservoir (Fitchburg/Westminster) has had an effective harassment program in place since the Fall of 2008. This program has substantially reduced the number of herring and great black-back gulls feeding at the site and subsequently utilizing the reservoir to roost. The harassment program should be monitored periodically to ensure its continued success.

2. **Owner Cooperation**
   Landfill owners are responsible for the control of gulls and preventing them from feeding on the active face. In general, most landfills within central Massachusetts have done a good job recently of controlling gull numbers and preventing feeding. Area landfills should continue to be monitored and owners encouraged to maintain a high level of harassment.

3. **Monitoring**
   In the future, area landfills will be periodically monitored to determine if existing harassment programs are still effective.

Reservoir Harassment

The gradual reduction in available food resources, coupled with the gulls documented mobility and willingness to travel, should result in fewer gulls feeding in central Massachusetts and thereby fewer gulls utilizing the reservoirs. However, because it is unclear how long it may take to effect this change, continued reservoir harassment is critical to the program's success. In addition, modifications to the program to make the reservoirs more unattractive may encourage local gulls to seek out alternate roosts. As demonstrated in this study, gulls will utilize other water bodies in central Massachusetts as a roosting area, particularly during early fall and winter when open water is still available throughout the state. Some or all of the following modifications could be tried and evaluated by the Division's Gull Harassment Program.

1. **Lasers**
   As described earlier, gulls are very visually attuned to their surroundings and quickly become wary when conditions change or a perceived threat exists. Lasers have been used successfully to deter other bird species from roosting or perching sites[3]. At the reservoir, land-based green lasers could be set up and operated to establish a large grid pattern over critical areas (i.e. the intake, shallows, mid reservoir, etc.). These lasers could be set up so they are visible even during daylight, and project just above the water's surface. A small experimental control area could be established to test their effectiveness.

2. **Increased Harassment Pressure**
   The active harassment zone at both Wachusett and Quabbin Reservoirs is currently comprised of only a portion of the whole reservoir. Gulls are allowed to roost undisturbed outside this zone. It may be possible to extend the harassment zone at Wachusett Reservoir to include the whole reservoir, thereby preventing any roost from forming. While whole reservoir harassment was tried once in the past (and failed), it may be worth another attempt but with a modified approach.

   Any whole reservoir harassment program should begin immediately when the gull numbers begin to increase at the roost. Waiting until the roost is large and well established will only make it more difficult to make them leave. Harassment must be done consistently, with adequate resources, and for enough time. It is unclear how much harassment may be necessary to displace the roost. However, it is clear that since the roost has been utilized for decades, it will take a substantial investment of time and resources. Multiple boats patrolling the whole reservoir, a zero tolerance for any landing gulls, and operations well after sun down may be necessary, especially during the early stages of the program. However, given the size of Wachusett Reservoir, the success in other states with this type of program, the documented use of other roosting sites, and the mobility of the gulls, it is possible that the gulls can be driven onto another roosting location. Increased harassment, coupled with the gradual reduction in local gulls populations would mean that as gulls numbers go down, the intensity of the harassment would diminish as well.

Table 8. Proposed Management Recommendations Time Line, 2010-2011

Activity	Time Period
Parking Lot Pilot	August 2010-December 2010
Waste Water Plants	August 2010-March 2011
Parking Lots All	December 2010-December 2011
Lasers	September-October 2010; September-December 2011
Modified Harassment	September-December 2011

[3] Blackwell, B. F. et al. 2002. *Lasers as Non-lethal Avian Repellents.* J. Wildl. Manage. 66:250-258.